

M. E./M. Tech. (First Semester)  
EXAMINATION, Jan./Feb., 2008

## ADVANCED COMPUTATIONAL MATHEMATICS

(MCSE-101)

Time : Three Hours

Maximum Marks : 100

Minimum Pass Marks : 40

**Note :** Attempt any five questions. All questions carry equal marks.

1. (a) Examine whether the system of vectors  $a_1 = (1, 2, 3)$ ;  $a_2 = (1, 0, 1)$  and  $a_3 = (0, 1, 0)$  are linearly dependent or not.
- (b) In the differential equation  $y'' + 4y' + 6y = 0$ ; verify that the given functions  $e^{-2n}$ ,  $e^{-3n}$  on  $(-\infty, \infty)$  are solutions. Determine whether they are linearly independent and whether they form a basis for solution space.
- (c) Define hash function.

- (d) Given the mathematical definition and pictorial representation of unit step Heaviside function. Also give engineering application of this function.

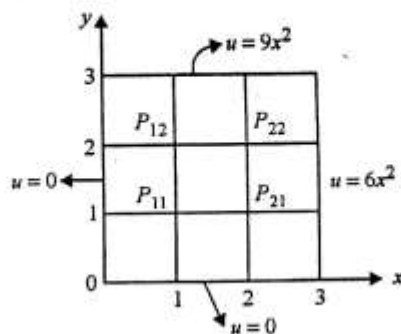
2. (a) Give mathematical formula : for  $He_n(x)$  (Hermite polynomial) and show that :

$$He_3(x) = x^3 - 3x.$$

Also write weight function for Hermite-polynomial to be orthogonal.

- (b) What are error functions (give Mathematical definition) and why they are called error functions ?
- (c) (i) Explain K (Mod M).  
(ii) In 'Clock' arithmetic or arithmetic modulo 12 write the values of  $6 + 9$ ;  $7 \times 5$ ;  $1 - 5$ ,  $2 + 10$ .

3. (a) Explain Wavelet transform and where it is used.
- (b) Solve the mixed boundary value problem for the Poisson's equation.  $\nabla^2 u = 2(x^2 + y^2)$ ; for the region and for the boundary conditions as shown in figure below :



4. (a) Find the Fourier transform of rectangular pulse :

$$f(t) = \begin{cases} 1 & \text{for } 0 < t < T \\ 0 & \text{otherwise.} \end{cases}$$

- (b) Define Discrete Fourier transform and write two properties :  
(i) Periodicity (ii) Linearity.
- (c) Explain use of WFT.
- (d) Give the concept of Fuzzy set.
5. (a) If the probability of obtaining a correct answer is  $p = 0.01$ , what is the probability that out of set of 100 questions more than 2 will be wrong. Find using Binomial and Poisson's distribution separately.
- (b) Explain point estimate and interval estimate (confidence interval).
- (c) What do you mean by significance level ? Explain the types of errors in tests.
- (d) Define transient and steady state queuing system.
6. (a) Show that every stochastic process  $\{x_t, t = 0, 1, 2, \dots\}$  with independent increment is a Markov process.
- (b) Find a differential equation of pure death process. If the process starts with  $i$  individuals, find the mean and variance of the number  $N(t)$  present at time  $t$ .
7. (a) Obtain the steady state difference equations for the queuing model  $(M/M/1 : N/FaFs)$  is usual notation and solve them for  $P_0$  and  $P_1$ .
- (b) What is Poisson's queue ?
- (c) Define mother wavelet.
- (d) Write the MATLAB program for the generation of unit step sequence  $[u(n) - u(n - N)]$ .
8. (a) Define stochastic (Markov) matrix.
- (b) Exactly what will be displayed after the following MATLAB commands are typed ?

```
>> x = 2;
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>> x ^ 8;
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>> y = 8 - x.
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- (c) Define Fuzzy relations. Discuss Fuzzy if then rules with some examples.
- (d) Describe any two common one-dimensional membership function.